EXHIBIT 427

Price Discovery on the NYSE and the NASDAQ: The Case of Overnight and Daytime News Releases

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We examine the market response to quarterly earnings announcements made during trading and nontrading hours on the NYSE and the NASDAQ. For nontrading-hours announcements, the opening trade on the NYSE impounds most of the price response, whereas for trading-hours announcements, the response is spread evenly over the first several post-announcement trades. In contrast, the first post-announcement trade on the NASDAQ impounds most of the price response regardless of announcement time. These results suggest that the different trading environments on the two exchanges (e.g., specialist versus dealer market, call auction versus continuous trading, etc.) may differ in their ability to impound information.

■ The purpose of this paper is to examine the stock market response to earnings announcements made 1) during the trading day and 2) during the institutionally-imposed overnight period of no trading on the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotation system (NASDAQ). On each exchange, there are two reasons to expect that the response to news released during trading hours differs from the response to news released during nontrading hours. First, if news is released during the institutionally-imposed overnight period of no trading, there is additional time for broad dissemination of the news as well as time for investors to submit new orders or change existing orders. Thus, the first post-announcement price may be more informative for nontrading-hours announcements. Second, both the NYSE's and the NASDAQ's opening procedures differ from trading procedures employed during the rest of the trading day. In particular, the NYSE employs a call market mechanism at the open but a continuous auction mechanism thereafter.[1] If these mechanisms differ in their ability to impound information into prices, then we may observe different price adjustments following news announcements made during nontrading and trading hours. On the NASDAQ, a quote driven, dealer market is employed for all transactions.[2] However, the opening trade is preceded by a period of informal price discovery by dealers. If pre-opening informal price discovery contributes to a more informative opening price, we may observe a different price adjustment to news announcements made during nontrading hours.

In order to evaluate the effect of announcement time and market microstructure on price discovery, we examine the market response to quarterly earnings announcements made by 100 NYSE firms and 100 NASDAQ firms during the 1990-1994 time period. We find that on a transaction-by-transaction basis, immediate post-announcement price discovery differs for trading- and nontrading-hours announcements on the NYSE but not on the NASDAQ. In particular, on both exchanges, the majority of the price response

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[1] The NYSE's call market uses consecutive batching of many orders that are crossed at one market clearing price. In continuous auction trades are executed sequentially at potentially different prices.

[2] The NASDAQ is a decentralized, computer-based system of bid and asked prices submitted by various dealers.

to nontrading hours. Earnings announcements are realized during the opening trade. However, on the NYSE, the price adjustment to trading-hours earnings announcements is spread evenly over the first several post-announcement trades, whereas on the NASDAQ, the price adjustment to trading-hours earnings announcements is concentrated in the first post-announcement trade with only relatively slight adjustment in the next several transactions. Thus, transaction time analysis indicates some differences in price discovery; however, when calendar time is considered, price adjusts rapidly over the first post-announcement half hour for both types of announcements on both exchanges. Thus, the significant differences in price discovery are concentrated in the transactions immediately following the release. Consistent with prior research, we find that post-announcement trading volume is abnormally high and stays elevated into the next trading day regardless of announcement time or exchange.

Our research contributes to the security market microstructure literature in two ways. First, the speed and accuracy of price determination in capital markets is important to individual and institutional investors alike, since poorly timed or mispriced orders can reduce realized returns. Furthermore, as Schwartz and Shapiro (1990) note, "Some market participants (day traders in particular) may profit from mispricing and the excessive short-run volatility it creates." This research provides empirical evidence on the extent and duration of possible mispricing around earnings announcements made at different times of the day.

Second, as trading becomes more global (e.g., some stock exchanges are changing their microstructure to adapt to additional volume, and new exchanges are emerging) and as the major U.S. stock exchanges move toward around-the-clock trading, it is important to understand how different auction mechanisms and the dealer or specialist systems themselves may affect the price adjustment to major news releases.

The rest of the paper is organized as follows. In Section I, we describe the information disclosure environment for publicly traded firms and develop testable hypotheses. In Section II, we discuss the data and present the results of the empirical tests. In Section III, we offer concluding remarks.

I. Development of Hypotheses

The Securities and Exchange Commission requires "full and fair disclosure" of all material facts concerning securities of publicly traded companies. Some companies meet this requirement by disclosing material facts to financial newswire services (e.g., Dow Jones & Co., better known as the Broadtape), other newswire services (e.g., Associated Press), and newspapers.[3] Market sensitive financial information is generally broadcast over financial newswires within minutes of management's communication; thus, the broadcast usually represents the first "public" announcement of the news.[4]

The Broadtape runs from 8:00 a.m. until approximately 6:30 p.m. EST. However, the NYSE and the NASDAQ are open for trading between 9:30 a.m. and 4:00 p.m. EST. Thus, information can be released while these markets are closed if it is transmitted to Dow Jones between 8:00 a.m. and 9:30 a.m. or between 4:00 p.m. and 6:30 p.m.

As noted in the introduction, there are several reasons to expect differences in the price discovery process to news announced during trading and nontrading hours. First, announcement time may affect the degree to which the information is disseminated before the first post-announcement trade. More specifically, if news is released during nontrading hours rather than during the trading day itself, the news is more likely to be fully disseminated before trading begins. Accordingly, investors, as well as the NYSE specialists or the NASDAQ dealers, will have had more time to consider the pricing implications of the news.[5] Second, if news is announced during nontrading hours, investors are likely to have more time to submit new orders or change existing orders after considering the new information.[6] Third, the opening procedure on both exchanges differs from the procedures employed for the rest of the trading day.

Specifically, on the NYSE a call (i.e., batch) auction opens trading. During this opening procedure, NYSE specialists (the sole market makers in the stock) determine the opening price by balancing the buy and sell orders submitted overnight.[7] If news is announced during trading hours, on the

[3] Earnings, dividend announcements, merger or acquisition offers, tender offers, stock splits, management changes, and substantive items of non-routine income are among the events that are immediately disclosed by publicly traded firms.

[4] See Frost, Pagach, and Stephan (1992) for a discussion of Broadtape reporting procedures.

[5] In fact, the American Stock Exchange, in its company manual, encourages firms to release information after the markets are closed so that the news will be more widely disseminated before trading begins the next day.

[6] If news is released during the trading day, on the other hand, traders with particularly easy access to the trading mechanism can and do attempt to earn short-term profits by reacting instantly to the news, while other investors are receiving and interpreting the news and forming trading strategies (see Brown, Chui, and Hooper, 1992). This may inhibit rapid response by investors without this special access and thus not allow price to reflect their information.

[7] These orders come from three sources: limit orders, the crowd of traders around the specialist, and SuperDOT. Specialists may solicit additional orders and may announce trial clearing prices (often called "indications") to brokers in the crowd before settling on an opening price. Often specialists must buy or sell from their own inventory during this procedure. Typically, the number of shares changing hands in the first

other hand, the first post-announcement price on the NYSE is determined by the continuous auction mechanism in place throughout the rest of the trading day.[8] Thus, on the NYSE, the first post-announcement trade following a nontrading-hours announcement represents a batching and execution of many orders, whereas the first post-announcement trade following a trading-hours announcement represents the execution of only one order. After the open, specialists are charged with maintaining "fair and orderly" markets (e.g., maintaining a smooth sequence of prices and avoiding large price changes between successive trades) while competing with floor traders and limit orders. Because call and continuous trading mechanisms may differ in their ability to impound information in price and because specialists are required to maintain price continuity during the trading day, it is possible that the price discovery process will differ for trading- and nontrading-hours announcements on the NYSE.[9]

On the NASDAQ, a quote-driven, dealer market mechanism is employed for all transactions during the trading day, with dealers having minimal obligations.[10] Thus, on the NASDAQ, all trades represent the execution of one order, and none represent a batching and execution of many orders during one transaction. However, even though there is no formal call market opening on the NASDAQ, the open of trade is preceded by informal price discovery. Specifically, during the pre-opening hours, NASDAQ dealers familiarize themselves with relevant news stories breaking overnight and attend research and trading meetings. During the (approximately) one half hour before the opening of trading, they also post non-firm quotes (that is, quotes that they do not have to honor).[11] This pre-opening activity may affect the informativeness of the first post-announcement trade's price. Despite this, since both the NYSE's and the NASDAQ's opens are preceded by an overnight period of no trading, an analysis of price discovery after nontrading-hours announcements on both exchanges can yield insight into the relative effectiveness of the opening procedures in producing informative prices.

The previous discussion reveals that because of differences in the technical aspects of trading at certain times of the day, price discovery may differ depending on whether the news is announced during trading hours or nontrading hours, regardless of the exchange. It is also clear, however, that if announcement time is held constant, price discovery may depend on the exchange. These considerations lead to the following four null hypotheses.

H_{01}: There is no difference in the price discovery process following trading- and nontrading-hours news announcements on the NYSE.

H_{02}: There is no difference in the price discovery process following trading- and nontrading-hours news announcements on the NASDAQ.

H_{03}: There is no difference in the price discovery process following nontrading-hours news announcements on the NYSE and the NASDAQ.

H_{04}: There is no difference in the price discovery process following trading-hours news announcements on the NYSE and the NASDAQ.

II. Empirical Tests

In this section, we test these hypotheses by examining the market response to quarterly earnings announcements made by a sample of NYSE and NASDAQ firms.

A. Sample and Data

The sample is comprised of quarterly earnings announcements for 100 NYSE and 100 NASDAQ firms over the 1990–1994 time period.[12] We obtained quarterly earnings forecasts and actual earnings per share for all sample firms over the relevant time period from Lynch, Jones & Ryan's Institutional Brokers Estimate System (I/B/E/S) detail tapes, and we obtained price, volume, and time-of-trade data from the Institute for the Study of Securities Markets (ISSM) database (years 1990–1992) and from the NYSE's Trade and Quote (TAQ) database (years 1993 and 1994). Means, medians, and standard deviations of selected descriptive variables for the sample firms are presented in Table 1. As the table indicates, both NYSE and NASDAQ firms are fairly large and actively traded. However, as expected, NASDAQ

transaction of the trading day significantly exceeds that of the next several transactions.

[8] This assumes that no trading halt is declared because of the news.

[9] It is also possible that a different price response to trading-hours news announcements could arise because specialists, in satisfying their obligation to submit [illegible] orders, "walk the book" of the limit order when adjusting price for new information released during trading hours. We thank an anonymous reviewer for suggesting this explanation.

[10] Dealers are contacted directly or by brokers, and execute trades on their own account. Thus, dealers compete with other dealers who are also making a market in their stocks.

[11] The posting of non-firm quotes by NASDAQ dealers is analogous to the "calling out of indications" by NYSE specialists.

[12] The 100 NYSE and the 100 NASDAQ firms were randomly selected from all NYSE and NASDAQ firms whose stocks were traded at least 50 times per day, on average, over the 1990–1994 time period. We used this "minimum transaction frequency" criterion to help ensure that firms in our sample were visible enough to be followed by financial analysts and have their quarterly earnings announcements broadcast over financial newswires and contained on the Dow Jones News/Retrieval text database.

Table 1. Means and Medians of Selected Variables for the Sample Firms

The analysis is conducted over the 1990-1994 period. The NYSE sample consists of 120 firms randomly drawn from those NYSE firms with an average of at least 10 transactions per day over the 1990-1994 period. The NASDAQ sample consists of 180 firms randomly drawn from those NASDAQ firms with an average of at least 10 transactions per day over the 1990-1991 period. Size is measured on the basis of market value of equity. Daily relative volume is calculated by dividing the number of shares traded during a particular day by the number of shares outstanding on that day. Medians are presented in parentheses.

Variable	NYSE	NASDAQ
Size ($000)	$1,544,855	$836,631
	(1,382,861)	(394,992)
Shares Outstanding (000)	82,346	33,381
	(58,303)	(19,223)
Daily Relative Volume	0.003022	0.01213
	(0.002373)	(0.010056)
Transactions per Day	143	184
	(94)	(87)
Daily Trading Volume in Shares	249,110	340,973
	(151,447)	(175,069)
Transactions Size in Shares	1,615	1,890
	(1,592)	(1,820)
Dollar Volume per Transaction	$51,442	$40,337
	(38,511)	(35,867)
Number of North American Exchange Listings	6	1

firms are smaller, on average, than NYSE firms (e.g., average market value of equity of $877 million versus $3.1 billion for NASDAQ and NYSE firms, respectively). All volume measures are higher for NASDAQ firms (e.g., average daily volume of 340,973 shares and 249,110 shares for the NASDAQ and NYSE firms, respectively).[13]

We searched the Dow Jones News/Retrieval text database to find the day, hour, and minute of the initial broadcast of the sample firms' quarterly earnings figures over the Broadtape during the 1990-1994 time period. An announcement found in the Dow Jones database was included in our sample if 1) associated analyst forecasts of that quarter's earnings per share and that quarter's actual earnings per share were available on the I/B/E/S detail tapes and 2) there was sufficient estimation and event period data available via the ISSM and/or TAQ tapes. This sample selection process yielded 1,307 NYSE quarterly earnings announcements and 1,187 NASDAQ quarterly earnings announcements. Of the NYSE announcements, 5 made during trading hours were associated with trading halts. They were not included in our group of trading hours announcements but rather were analyzed separately as a group of trading hours announcements that were associated with trading halts.[14] To determine whether the price adjustment observed for the sample as a whole differs from that observed when only particularly surprising announcements are considered, we calculated an associated analyst forecast error, based on the mean analyst forecast in the last month that I/B/E/S forecasted quarter t earnings for firm i, for each of our sample earnings announcements. Specifically, the analyst forecast errors (AFE_{it}) were calculated as follows,

$$AFE_{it} = \frac{ACTUALEPS_{it} - IBESFORECAST_{it}}{|IBESFORECAST_{it}|}$$

where

AFE_{it} = Analyst forecast error for firm i in quarter t

$ACTUALEPS_{it}$ = Actual earnings per share for firm i in quarter t

$IBESFORECAST_{it}$ = Mean I/B/E/S analyst forecast for firm i's earnings per share for quarter t in the last month quarter t earnings per share were forecasted

[13] There are two reasons to expect such a result. First, NYSE specialists frequently simply cross investor orders, whereas NASDAQ dealers would participate on both sides of such a trade. Second, at times, NASDAQ dealers trade shares among themselves in order to facilitate a trade with an investor. Because each NYSE stock is assigned to one (and only one) specialist, similar facilitating trades among specialists are much less likely to take place.

[14] Earnings announcements are rarely accompanied by trading halts.

Thus, analyst forecast errors in this study are simply proportional deviations of actual earnings per share from the most recent mean I/B/E/S analyst forecasted earnings per share for the same firm and quarter. We assume that these analyst forecast errors proxy for the unexpected component of (i.e., the magnitude of the surprise in) the earnings figures released to the market.[15] The mean (median) AFE for the NYSE trading-hours group (N = [illegible]) is 0.3491 (0.[illegible]) with a standard deviation of 0.71[illegible]. The mean (median) AFE for the NYSE nontrading-hours group (N = 807) is 0.3012 (0.1244) with a standard deviation of [illegible]717. The mean (median) AFE for the NASDAQ trading-hours group (N = 3,[illegible]) is 0.3594 (0.1429) with a standard deviation of 0.7020. The mean (median) AFE for the NASDAQ nontrading-hours group (N = 8,[illegible]) is 0.[illegible] (0.1533) with a standard deviation of [illegible].[16] The mean (median) AFE for the NYSE trading-halt group (N = [illegible]) is 0.4592 (0.[illegible]) with a standard deviation of 0.[illegible]336.

B. Transaction Time Analysis-Returns Tests

In this section, we measure the speed of adjustment in transaction time by examining the magnitude of abnormal stock returns (on a transaction-by-transaction basis) resulting from a trading strategy based on the sign of the AFE. The strategy we use is similar to the one used in Patell and Wolfson (1984): We buy the stock if the AFE is positive and sell it short if the AFE is negative. We calculate event period abnormal transaction returns by adjusting each observed raw transaction return for a firm-, quarter-, and time-of-day-specific average transaction return. We adjust raw returns in this manner to control for 1) the U-shaped pattern in intraday returns first documented in Harris (1986) and 2) the possibility that firms that release news during nontrading hours may systematically differ from those that release news during trading hours. With regard to the second reason, if the characteristics of firms that release news at certain times affect their return generating process, then adjusting raw event-period returns by firm-specific average returns provides some control for the effects of these characteristics and facilitates comparisons.[17]

The average transaction returns are calculated for 15-minute intervals beginning at 9:30 a.m. and ending at 4:00 p.m. for each firm in each quarter during days [illegible] to -26 (relative to the earnings announcement day, which is considered day [illegible]). Thus, for each firm in each quarter, we calculate the average transaction return observed during 15-minute intervals throughout the trading day during a quarter-specific estimation period. We adjust each firm's raw event period transaction returns by the average transaction return calculated for that firm in the appropriate quarter and during the appropriate 15-minute interval.

Table 2 contains the results of the strategy for all of the NYSE trading- and nontrading-hours announcements. Table [illegible] contains the results of the strategy for all of the NASDAQ trading- and nontrading-hours announcements. Holding period abnormal returns are measured from transaction to transaction, beginning with the tenth transaction *before* the release and ending with the twenty-fifth transaction after the release. Mean abnormal returns are presented for each transaction, along with t-statistics from one-sided tests of the null hypothesis of zero abnormal returns. We also measure the mean cumulative abnormal return (mean CAR) earned between transactions -10 and +25 and show the cumulative percentage of that total mean CAR earned after each transaction.

As Table 2 shows, for the NYSE trading-hours announcements, statistically significant positive abnormal returns accrue for six of the first seven post announcement

[15] It should be noted that the proxy we choose for the market's expectation of current earnings is critically important in determining the amount of measurement error in the earnings shock we calculate. The conclusions of studies that compare the accuracy of time-series and financial analysts' forecasts of earnings is that analysts' forecasts are, on average, more accurate than time-series forecasts and are more highly associated with stock price movements over short (i.e., two-day) windows (e.g., Givoly, Hayes, and [illegible], 1987a and 1987b; Brown and Rozeff, 1978; and Fried and Givoly, 1982). Because of this evidence, we use I/B/E/S earnings forecasts in this paper.

[16] Neither the mean nor the median AFEs for the NASDAQ trading- and nontrading-hours announcements are significantly different from one another. The median AFEs for the NYSE trading- and nontrading-hours announcements are not significantly different from one another using the nonparametric median test. However, the mean AFEs for the NYSE trading- and nontrading-hours announcements are significantly different from one another at the 0.05 level (using a standard t test) with the nontrading-hours announcements having a [illegible] average AFE.

[17] A comparison of the profiles of firms whose managers made at least 80% of their earnings announcements during nontrading hours (N = 1[illegible] out of 100 NYSE firms; N = 20 out of 100 NASDAQ firms) and firms whose managers made at least 80% of their earnings announcements during trading hours (N = [illegible] out of 100 NYSE firms; N = 15 out of 100 NASDAQ firms) indicates some differences. In particular, the trading-hours announcers tend to be smaller than the nontrading-hours announcers on both exchanges (mean market value of equity of $2.4 billion vs. $[illegible] billion for the NYSE trading-hours and nontrading-hours announcers, respectively, and $4.0 million vs. [illegible] billion for the NASDAQ trading-hours and nontrading-hours announcers, respectively). Trading volume also tends to be higher for the nontrading-hours announcers on both exchanges (mean daily volume of 203,[illegible] shares vs. [illegible]90,[illegible]37 shares for the NYSE trading-hours and nontrading-hours announcers, respectively, and [illegible]24 shares vs. [illegible]0,105 shares for NASDAQ trading-hours and nontrading-hours announcers, respectively). All other firms (N = 17[illegible]) announced both during trading and nontrading hours and tended to be somewhere in between the other two types of firms (mean market value of equity $4.6 billion and $[illegible] million for the NYSE and the NASDAQ mixed announcers, respectively, and mean daily volume of 242,755 shares and 2[illegible] shares for the NYSE and the NASDAQ mixed announcers, respectively).

Table 2. Average Abnormal Transaction Returns Earned by a Trading Strategy of Buying Stocks with Positive Analyst Forecast Errors and Selling Short Those with Negative Analyst Forecast Errors: NYSE Announcements

Abnormal transaction returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. NYSE announcements are those 1,002 quarterly earnings announcements (excluding the 5 announcements that were accompanied by trading halts) made by 100 NYSE firms during the 19[illegible] 1984 time period. Trading-hours announcements (N = 500) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements (N = 502) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 5:30 p.m. EST. t-statistics are for the test of the null hypothesis of zero abnormal [illegible] against the alternative [illegible] positive abnormal [illegible].

	Trading-Hours Announcements			Nontrading-Hours Announcements		
Transaction Relative to the Release	Mean Abnormal Return	Cum. % of Total Abnormal Return (%)	t-Statistic	Mean Abnormal Return	Cum. % of Total Abnormal Return (%)	t-Statistic
-10	-0.0002	[illegible]	[illegible]	0.0002	1.04	0.8950
-9	0.0002	[illegible]	[illegible]	[illegible]	0.97	-0.5765
-8	-0.0003	-6.12	-1.8914	[illegible]	0.97	-0.1100
-7	[illegible]	0.00	1.4724*	-0.0001	0.00	0.8001
-6	[illegible]	2.0[illegible]	0.6129	0.0002	1.94	1.1961
-5	[illegible]	[illegible]	[illegible]	[illegible]	1.94	-0.1378
-4	0.0004	8.16	2.3850***	[illegible]	0.00	0.8052
-3	0.0000	8.16	0.1868	0.0002	[illegible]	0.8628
-2	-0.0001	6.12	-0.2740	0.0002	[illegible]	1.2[illegible]
-1	0.0002	10.20	0.9268	0.000[illegible]	6.80	[illegible]
+1	0.0007	[illegible]	[illegible]178***	0.0071	75.73	7.9[illegible]***
+2	0.0005	[illegible]	[illegible]***	0.0000	75.73	0.3085
+3	0.0005	44.[illegible]	2.1[illegible]**	0.0001	76.70	1.0555
+4	0.0002	48.[illegible]	0.87[illegible]	0.0004	80.58	2.9572***
+5	0.0004	57.14	1.7654*	0.0003	83.49	1.9282*
+6	0.0005	67.[illegible]	2.1120**	-0.0001	82.52	-0.58[illegible]
+7	0.0005	[illegible]	2.50[illegible]**	0.0000	82.52	0.24[illegible]
+8	0.0001	79.59	0.726[illegible]	0.0007	89.32	1.0740
+9	-0.0002	75.51	-1.0161	0.00[illegible]	[illegible]9.32	-0.0823
+10	0.0003	81.63	1.5149*	0.0001	90.[illegible]	0.6291
+11	0.0002	85.71	0.7869	0.0002	92.2[illegible]	1.6904**
+12	0.0005	[illegible]	2.2581**	-0.0001	91.26	0.5190
+13	-0.0001	[illegible]	[illegible]	0.0001	92.23	0.6811
+14	-0.0002	89.80	-1.[illegible]	0.0001	93.20	0.3815
+15	-0.0001	87.76	-0.6740	0.0003	96.12	1.5735*
+16	0.0002	91.84	0.9262	0.0000	96.12	0.0576
+17	0.0001	93.88	0.6333	0.0001	97.08	0.2893
+18	0.0001	[illegible]92	0.3005	0.0001	98.06	0.6218
+19	0.0001	[illegible]96	[illegible]376	0.0000	98.06	0.0310
+20	-0.0002	93.88	-1.164	-0.0005	93.20	-2.1157
+21	0.0002	97.96	1.0363	0.0001	94.17	0.[illegible]582
+22	-0.0002	93.88	-0.8145	0.0001	95.15	0.7056
+23	0.0001	[illegible]92	0.6066	-0.0001	94.17	0.6998
+24	0.0004	104.[illegible]	1.[illegible]**	0.0002	96.12	1.1307
+25	-0.000[illegible]	100.00	-0.8508	0.0004	100.00	3.0398***

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

transactions, with the first post-announcement transaction (transaction +1) accounting for [illegible]% of the total CAR earned by transaction +25 (the mean abnormal return for transaction +1 is [illegible]%, which is significant at the 0.01 level).[18] Approximately 78% of the total CAR accrues by transaction +7, with abnormal returns earned relatively evenly over the first seven transactions. In contrast, statistically significant positive abnormal returns accrue in only three of the first seven post-announcement transactions for the NYSE nontrading-hours announcements. The first post-announcement transaction (the opening transaction after the announcement) accounts for 69% of the total CAR earned by transaction +25 (the mean abnormal return for this transaction is 0.71%, which is significant at the 0.01 level), and 83% of the total CAR accrues by transaction +[illegible].[19]

The data in Table 2 indicate that regardless of when the announcement is made, approximately 80% of the total CAR is earned by the seventh post-announcement transaction. There is, however, one important difference in the price discovery processes. If the announcement is made during trading hours, the first post-announcement transaction accounts for only 14% of the total CAR, whereas if the announcement is made during nontrading hours, the first post-announcement transaction (the overnight trade) accounts for [illegible]% of the total CAR.[20] Figure 1 contains graphs of CARs calculated from the abnormal returns presented in Table 2 and illustrates the difference in the price discovery processes. This difference supports the rejection of H_{01}, which posits no difference in the price discovery process following announcements made during trading and nontrading hours on the NYSE.[21] Using a measure of dispersion developed in Glasser (1962), we formally reject H_{01} at the 0.01 level.[22]

Table 3 contains the results of the trading strategy for all of the NASDAQ trading- and nontrading-hours announcements. As the table shows, of the first seven post-announcement transactions for the NASDAQ trading-hours announcements, significant abnormal returns are earned in only transaction +1 (0.61% on average, p < 0.01), accounting for 72% of the total CAR earned by transaction +25.[23] Significant abnormal returns do not accrue again until transactions +1[illegible], +15, and +2[illegible] (0.1[illegible]% on average for the three transactions, all at p < 0.10). Significant abnormal returns are earned in four of the first seven transactions for the NASDAQ nontrading-hours announcements. However, during transaction +1, [illegible]% is earned on average, accounting for approximately 88% of the total CAR earned by transaction +25. Significant abnormal returns also accrue for transactions +2, +3, and +[illegible] (only 0.07% each), with 98% of the total CAR accruing by transaction +7.

The data in Table 3 indicate that on the NASDAQ, the first post-announcement trade impounds the majority of the price response to the news, regardless of when the announcement was made (72% and 88% in the trading- and nontrading-hours samples, respectively). Furthermore, 73% and 98% of the total CAR is earned by transaction +7 for the trading-hours and nontrading-hours announcements, respectively. Thus, the price discovery process is much more similar for trading-hours and nontrading-hours announcements on the NASDAQ than it is on the NYSE. For both types of announcements on the NASDAQ, the information appears to be impounded into the price after only a few transactions, with the majority being reflected in the first post-announcement trade. Figure 2 contains graphs of CARs calculated from the abnormal returns presented in Table 3 and illustrates the similarity in the price discovery processes. These results do not suggest that H_{02} can be rejected.

The similarity in price discovery processes for the NYSE and the NASDAQ nontrading-hours announcements, given that an overnight period of nontrading precedes the post-announcement opening of trade on both exchanges, is consistent with the notion that the NYSE's formal call market opening mechanism and the NASDAQ's informal pre-opening price discovery process are both effective in generating an informative opening price.[24] However, it is

[18]As Figure [illegible] and [illegible] show, prices are relatively stable by transaction +25. [illegible] also [illegible] calculate percentages of price adjustment relative to the total price adjustment by transaction +25.

[19]No significant abnormal returns are observed in transactions +2, +3, +6, and +[illegible].

[20]Recall [illegible], that on the NYSE, transaction +1 represents a batching [illegible] of [illegible] orders for nontrading-hours announcements, whereas it [illegible] the execution of only one order for trading-hours announcements.

[21]As noted in the sample description, we identified [illegible] announcements made during trading hours that [illegible] associated with trading halts. The small sample size precludes [illegible]; however, we calculated abnormal returns [illegible] for transactions [illegible] to +25 as well. We find an average [illegible] of 5.13% for transaction +1 (p < 0.01). [illegible] also observe significant abnormal returns for transactions [illegible], +4, +6, +[illegible], +12, +13, and +15, although these abnormal returns are no more than 0.13% apiece. The results are not inconsistent with the conclusions drawn in Lee, Ready, and Seguin (1994); however, it is not appropriate to draw strong conclusions from the small sample.

[22]Glasser's measure of dispersion is the [illegible] for computing a Gini coefficient.

[23]In fact, only [illegible] of the total CAR earned by transaction +25 is earned by transaction +7.

[24]However, recall that for our sample firms, the NASDAQ opening mechanism appears to impound slightly more of the nontrading-hours information into price. The overnight abnormal return accounts for 88% of the total CAR earned by transaction +25 on the NASDAQ, whereas on the NYSE, it accounts for 69%.

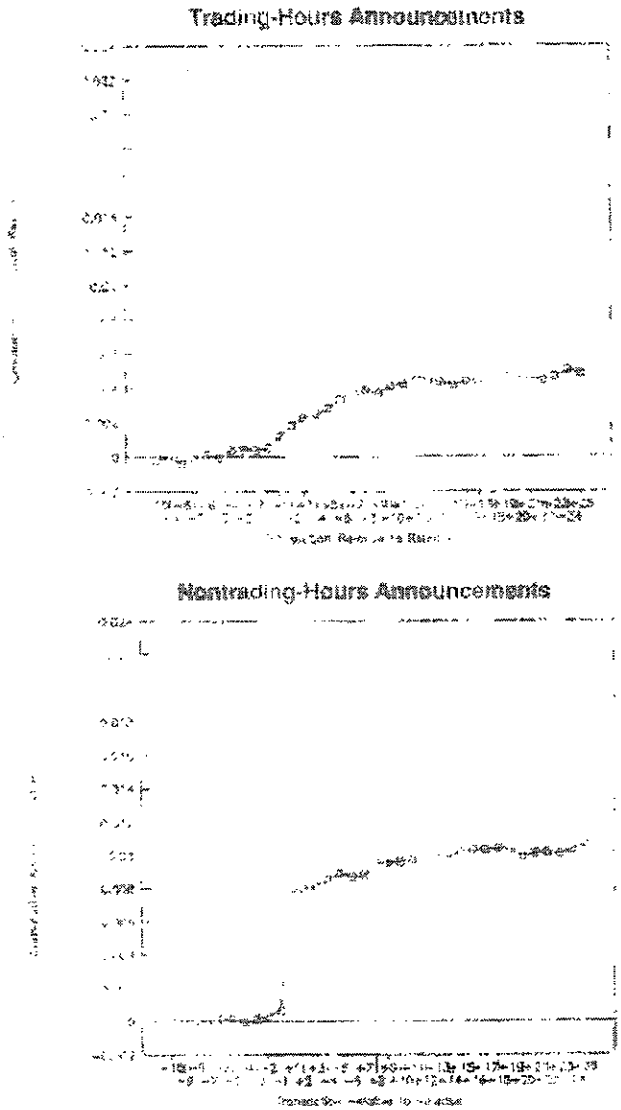
Table 3. Average Abnormal Transaction Returns Earned by a Trading Strategy of Buying Stocks with Positive Analyst Forecast Errors and Selling Short Those with Negative Analyst Forecast Errors: NASDAQ Announcements

Abnormal transaction returns are calculated by adjusting observed returns for a firm-specific, quarter-specific, and time-of-day-specific average return. NASDAQ announcements are the 1,165 quarterly earnings announcements made by 100 NASDAQ firms during the 1988–1990 time period. Trading hours announcements (N = 307) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading hours announcements (N = 858) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:05 p.m. and 6:30 p.m. EST. t-statistics are for the test of the null hypothesis of zero abnormal returns against the alternative of positive abnormal returns.

	Trading-Hours Announcements			Nontrading-Hours Announcements		
Transaction Relative to the Release	Mean Abnormal Return	Cum. % of Total Abnormal Return (%)	t-Statistic	Mean Abnormal Return	Cum. % of Total Abnormal Return (%)	t-Statistic
−10	0.0001	1.18	0.11[illegible]	0.0006	3.75	1.3269*
−9	−0.0009	−9.11	1.1968	0.0002	[illegible]	−0.5661
−8	0.0017	10.59	2.0010**	−0.0001	3.21	−0.2959
−7	−0.0014	−3.88	−1.6927	0.0003	4.59	0.7282
−6	0.0007	2.53	0.7528	0.0005	2.29	−1.2839
−5	−0.0005	−3.52	−0.6530	0.0001	1.83	−0.2328
−4	0.0003	1.18	0.4728	−0.0001	1.38	−0.3967
−3	0.0013	15.59	1.5189*	0.0007	4.59	1.5631*
−2	0.0011	2.35	1.3006	0.0002	5.90	0.4696
−1	0.0009	11.76	0.9554	−0.0009	1.38	−1.8919
0	0.0061	[illegible]	0.9735***	0.0092	89.45	10.8168***
+1	−0.0007	7[illegible]	−0.8853	0.0007	92.66	1.7374**
+2	0.0005	81[illegible]	0.6[illegible]	0.0007	95.87	1.5231*
+3	[illegible]	88.23	0.7750	0.0003	[illegible]	0.0691
+4	−0.0006	81.18	−0.9456	0.0001	96.79	0.2972
+5	0.0002	83.53	0.3478	0.0007	100.00	1.6648*
+6	−0.0009	72.94	−1.1417	−0.0004	98.17	−0.9195
+7	0.0004	77.65	0.[illegible]	0.0004	100.00	1.0643
+8	0.0009	88.24	1.1625	0.0001	100.46	0.2817
+9	0.0000	88.24	−0.0587	0.0004	102.29	1.4229
+10	0.0003	91.76	0.3818	−0.0003	100.92	−0.7479
+11	0.0001	93.94	0.1664	0.0000	100.92	0.0784
+12	0.0004	85.74	0.5732	0.0001	101.38	0.3147
+13	0.0010	100.00	1.2938*	0.[illegible]	104.59	1.7915**
+14	0.0012	114.12	1.5072	−0.0005	102.29	−1.2130
+15	−0.0008	104.71	−1.1547	−0.0008	98.62	−1.9319
+16	−0.0002	102.35	−0.2595	0.0004	100.46	1.0282
+17	0.0008	111.76	1.0178	0.0001	100.92	0.2908
+18	0.0001	112.94	0.1027	0.0002	100.00	−0.6441
+19	−0.0001	108.24	−0.5345	0.0001	100.46	0.3455
+20	−0.0001	102.35	−0.0661	0.0009	104.59	2.3152**
+21	0.0005	110.59	0.7663	−0.0005	102.29	−1.0194
+22	0.0002	124.71	1.5056*	0.0003	103.67	0.6537
+23	−0.0011	111.76	−1.5988	−0.0011	98.62	−2.7759
+24	−0.0010	100.00	−1.1643	0.0003	100.00	0.8110

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

Figure 1. Cumulative Abnormal Transaction Returns for Trading-Hours and Nontrading-Hours Earnings Announcements on the NYSE

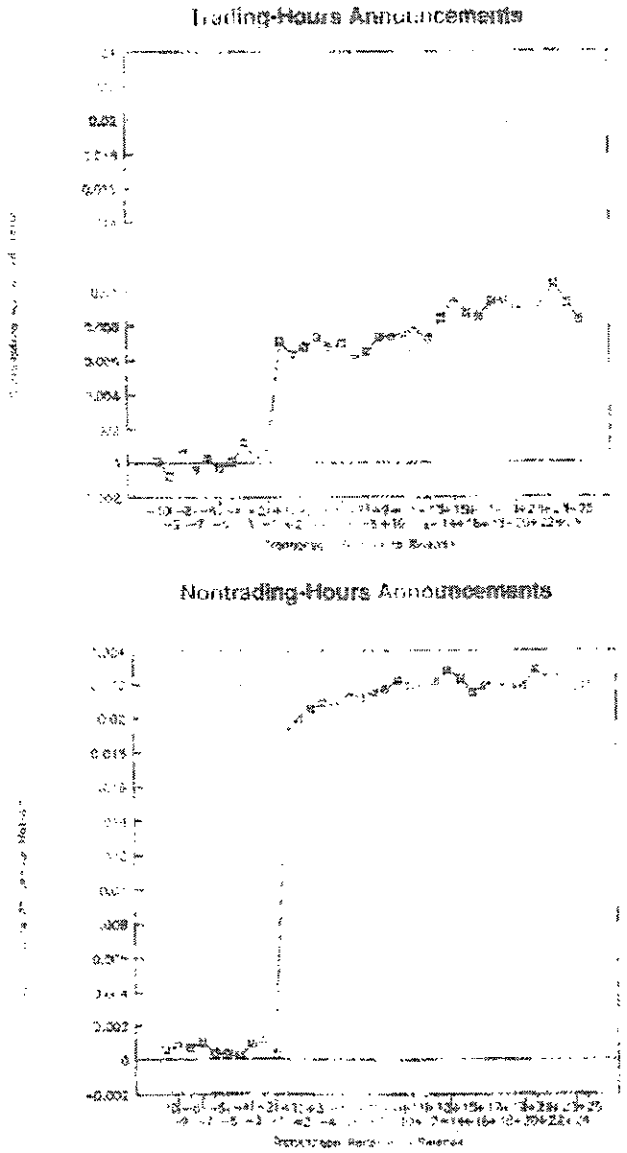


Abnormal transaction returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. NYSE announcements are those 1,302 quarterly earnings announcements (excluding the 4 announcements that were accompanied by trading halts) made by 100 NYSE firms during the 1988–1991 time period. Trading-hours announcements ($N = 500$) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements ($N = 802$) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST.

also possible that the overnight period of nontrading itself results in sufficiently broad dissemination of the information to produce an informative opening price and that this effect dominates.[25] If one could compare a wide variety of opening mechanisms, all of which are preceded by a nontrading

[25] In order to disentangle the effects of a nontrading period and the trading mechanism used to discover prices, Amihud and Mendelson (1991) examine the Bayesian mechanism employed on the Tokyo Stock Exchange (TSE). This mechanism is used to open trading at the beginning of the trading day and again after the two-hour lunch break. They find that prices are more volatile following the morning opening and conclude that while the Bayesian mechanism is employed, the length of the nontrading period has little influence

Figure 2. Cumulative Abnormal Transaction Returns for Trading-Hours and Nontrading-Hours Earnings Announcements on the NASDAQ



Abnormal transaction returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. NASDAQ announcements are the 1,187 quarterly earnings announcements made by 160 NASDAQ firms during the 1990-1991 time period. Trading-hours announcements (N = 349) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements (N = 838) are those announcements made between 8:01 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST.

discovery. It should be noted that the Bayose mechanism differs from the NYSE call market mechanism and the NASDAQ informal pre-opening price discovery in one important respect. Unlike the specialist and NASDAQ dealers, the saitori (TSE market maker) does not trade on their own account;

they are simply matchmakers. Had the TSE's market structure been the same as either the NYSE's or the NASDAQ's market structure, we could have used Amihud and Mendelson's (1991) results to help disentangle the effects discussed above.

period of the same length, and if they all perform essentially equally well, one could more confidently attribute an informative spread price to knowledgeable dissemination of the announcement.

Although price discovery following nontrading-hours announcements does not appear to vary significantly between the two exchanges, price discovery following trading-hours announcements does appear to differ. On the NYSE, six of the first seven post-announcement trades include the first, resulting in significantly positive abnormal returns, while on the NASDAQ, only the first post-announcement trade results in a significantly positive abnormal return. Thus, price discovery appears to require more transactions on the NYSE. This evidence supports rejection of H_{0B}. As noted in the previous section, one possible explanation for this result is that specialists on the NYSE are explicitly charged with maintaining "fair and orderly" markets. That is, they are required by the exchanges to attempt to maintain a smooth sequence of prices while markets are open and avoid large price changes between successive transactions. As noted in Cowan, Carter, Dark, and Singh (1992), NASDAQ dealers do not explicitly face a similar requirement. Thus, this institutional feature may cause prices to adjust more slowly to news announcements made during trading hours on the NYSE.

One important consideration is whether the base price discovery patterns are sensitive to the level of surprise in the earnings announcements. In order to examine this issue, we conducted analysis on various subsamples of announcements determined by the magnitude of the AFEs for the announcements. When only particularly surprising (AFE > 0.20) announcements are considered, similar patterns are observed in the average CARs. Figures 3 and 4 show graphs of the CARs accruing transaction by transaction from transaction −10 to transaction +25 for the NYSE and the NASDAQ AFE > 0.20 subsamples, respectively. As the figures show, the price discovery processes are similar to those observed for the sample as a whole although as expected, the magnitude of the price response to the more surprising announcements is larger. When the strategy is applied to announcements with AFEs > 0.15 and AFEs > 0.50, the basic price discovery patterns remain, and thus we conclude that they are not sensitive to the degree of surprise in the sample announcements.

Another important consideration is whether the basic price discovery patterns are sensitive to the "good" or "bad" nature of the surprise in the announcements (see Chari and Mohan (1994) for a discussion of the nature of news and its release time). In order to examine this issue, we split our NYSE sample into two subsamples: one that contained all earnings announcements with positive AFEs (a "good" news subsample) and one that contained all earnings announcements with negative AFEs (a "bad" news subsample). The basic price discovery patterns documented in Figures 1–4 remain, and so we conclude that the difference in price discovery between nontrading-hours and trading hours announcements is not driven by the good or bad nature of the news announced.[26]

C. Cross-Time Analysis-Returns Tests

In this section, we present the results of the trading strategy hypothesis tests, this time we measure returns in clock time. Tables 4 and 5 present the results of the trading strategy applied to the NYSE and the NASDAQ samples, respectively. Holding period abnormal returns in the tables are measured over 15-minute intervals, with the exception of period 0 returns for the nontrading-hours announcements (as discussed below). For trading-hours announcements, we examine 15 minute abnormal returns beginning an hour and a half before the announcement and continuing until an hour and a half after the announcement. Period 0 contains the announcement. In order to avoid maximum overnight and 15-minute trading day returns for our trading hours samples, we include only those transactions taking place during trading hours on the announcement day. For our nontrading-hours samples, we define period 0 as the overnight period containing the announcement for our samples. Period 1 for nontrading-hours announcements is the first 15 minute trading period after the opening transaction. We also present overnight returns for days +1 and for the first two 15-minute trading periods after the opening of trading on day +1 for all samples. Abnormal 15-minute returns are calculated as the difference between observed 15-minute returns and a firm-, quarter-, and time-of-day-specific average return (calculated over the same event estimation as described in the last section). Abnormal overnight returns are calculated as the difference between the observed overnight returns and an average firm-specific, quarter-specific overnight return (calculated over the same event estimation period).

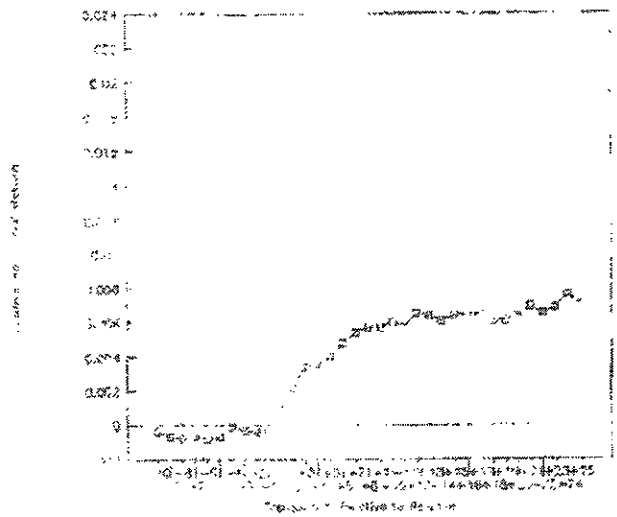
The data in Table 4 indicate that for the NYSE trading-hours announcements, 85% of the total CAR earned an hour and a half after the announcement is earned in the 15-minute period containing the release (mean abnormal return of 0.34%, $p < 0.01$).[27] In the next 15 minutes, an average abnormal return of 0.13% ($p < 0.01$) is realized. Throughout the next hour and 15 minutes, relatively small and statistically insignificant

[26] We thank an anonymous referee for suggesting that we consider this.

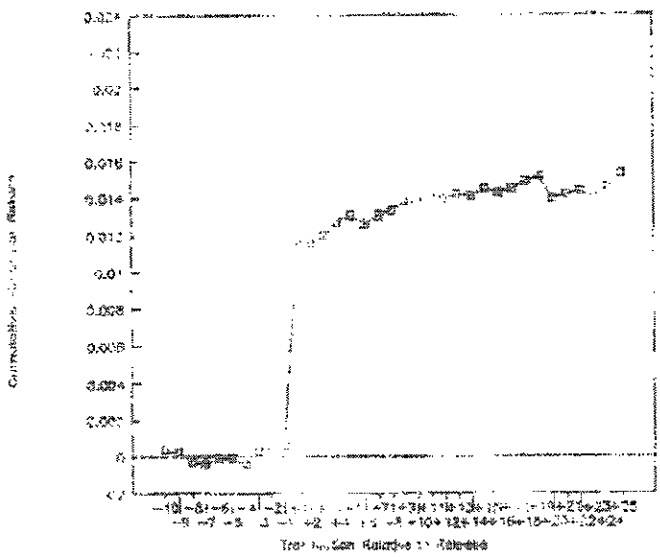
[27] Patell and Wolfson (1984) find an average of return of 0.23% in the first half-hour period following earnings releases made by their sample firms.

Figure 3. Cumulative Abnormal Transaction Returns for Trading-Hours and Nontrading-Hours Particularly Surprising Earnings Announcements on the NYSE

Trading-Hours Announcements



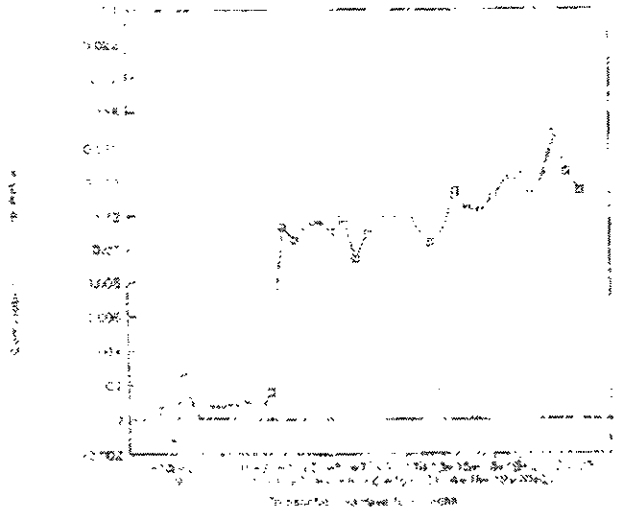
Nontrading-Hours Announcements



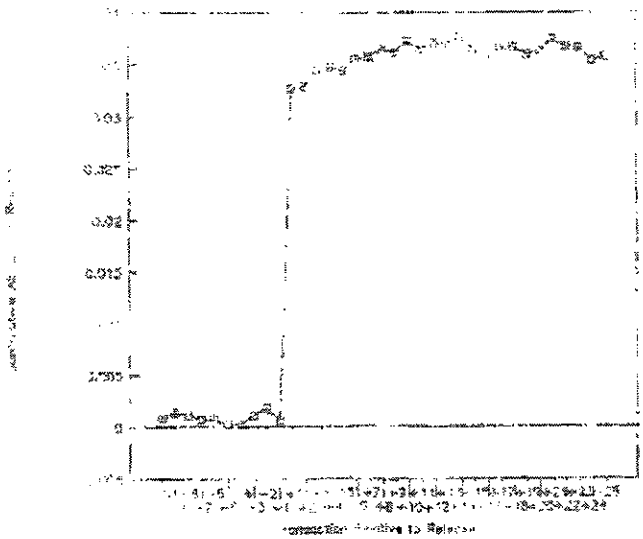
Abnormal transaction returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. Particularly surprising announcements are those with AFE > 0.20. Trading-hours announcements (N = 160) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading hours announcements (N = 320) are those made between 8:00 a.m. and 9:30 a.m. and 4:00 p.m. and 6:30 p.m. EST.

Figure 4. Cumulative Abnormal Transaction Returns for Trading-Hours and Nontrading-Hours Particularly Surprising Earnings Announcements on the NASDAQ

Trading-Hours Announcements



Nontrading-Hours Announcements



Abnormal transaction returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. Particularly surprising announcements are those with $|AFE| > 0.20$. Trading hours announcements ($N = 143$) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements ($N = 344$) are those made between 5:00 a.m. and 9:30 a.m. and 4:00 p.m. and 5:30 p.m. EST.

Table 4. Average 15-Minute and Overnight Abnormal Returns Earned by a Trading Strategy of Buying Stocks with Positive Analyst Forecast Errors and Selling Short Those with Negative Forecast Errors: NYSE Announcements

Holding period abnormal returns are measured in 15-minute intervals with the exception of Period 0 for the nontrading-hours announcements. For the trading-hours announcements, Period 0 is the 15-minute interval containing the release. For the nontrading-hours announcements, Period 0 is the overnight period containing the release and Period 1 is the first 15-minute period after the release. Abnormal returns are calculated by adjusting raw stock returns by firm- and quarter-specific and time of day–specific average returns. NYSE announcements are those of 940 quarterly earnings announcements, excluding the 5 announcements that were accompanied by trading halts, for 366 NYSE firms during the 1990-1994 time period. Trading hours announcements ($N = 500$) are those announcements made between 9:00 a.m. and 3:00 p.m. EST. Nontrading hours announcements ($N = 565$) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST. t-statistics are for the test of the null hypothesis of zero abnormal returns against the alternative of positive abnormal returns.

	Trading-Hours Announcements			Nontrading-Hours Announcements		
Holding Period Relative to Announcement	Mean Abnormal Return	Cum. % of Total Abnormal Return (%)	t-Statistic	Mean Abnormal Return	Cum. % of Total Abnormal Return (%)	t-Statistic
−6	−0.0003	−7.5	−1.178	0.0002	1.5	0.826
−5	0.0002	1.5	0.817	0.0011	8.5	2.221**
−4	0.0002	5.4	0.961	−0.0002	6.1	−0.697
−3	−0.0001	4.7	−0.636	0.0004	9.8	2.010**
−2	0.0001	−6.5	0.196	−0.0004	1.3	−1.489
−1	0.0001	3.9	0.728	0.0006	12.1	2.196**
0	0.0034	78.8	6.309***	0.0021	76.2	7.924***
+1	0.0015	116.0	2.855***	0.0011	87.1	3.265***
+2	0.0000	117.0	0.153	0.0009	94.9	2.350***
+3	0.0001	119.2	0.255	0.0001	95.9	0.337
+4	0.0001	118.2	−0.121	0.0001	97.2	0.505
+5	0.0000	103.7	1.629	0.0001	96.0	−0.484
+6	0.0002	100.0	−0.531	0.0004	100.0	1.877**
Following Overnight Days +1	0.0009		0.760	0.0005		1.187
+1	0.0003		0.343	0.0000		0.091
+2	0.0003		0.917	0.0002		0.682

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

15-minute abnormal returns (less than 0.05%) are earned. For the NYSE nontrading-hours announcements, the data in Table 4 clearly indicate that most of the price adjustment occurs in the overnight period containing the release (period 0), with 0.71% earned on average, $p < 0.01$. During the half hour after the opening transaction, significant but relatively small abnormal returns are earned: 0.12% in the first 15 minutes and 0.09% in the next 15 minutes.[28] After that, significant abnormal returns are not observed until period +6, and no significant abnormal returns accrue during the overnight period following the release or during the first half

[28] This finding of slight price drift in the post-opening period is consistent with the finding of slight price drift in the post-halt period in Hopewell and Schwartz (1978) and Lee, Ready, and Seguin (1994).

Table 5. Average 15-Minute and Overnight Abnormal Returns Earned by a Trading Strategy of Buying Stocks with Positive Analyst Forecast Errors and Selling Short Those with Negative Forecast Errors: NASDAQ Announcements

Holding period returns are measured in 15 minute intervals with the exception of period 0 for the nontrading hours announcement. For the trading-hours announcements, Period 0 is the 15-minute interval containing the release. For the nontrading-hours announcements, Period 0 [illegible] the overnight period containing [illegible] release, and Period [illegible] the first 15-minute period after the release. Abnormal returns are calculated [illegible] observed returns by [illegible] specific quarter [illegible], and time-of-day specific [illegible] return. NASDAQ announcements [illegible] 1,187 quarterly earnings announcements made by 100 NASDAQ firms during the 1990 [illegible] period. Trading-hours announcements [illegible] are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hour announcements (N = 8[illegible]) are announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and [illegible] EST. t-statistics are for the test of the null hypothesis of zero abnormal returns against the alternative of positive abnormal returns.

Holding Period Relative to Announcement	Trading-Hours Announcements: Mean Abnormal Return	Trading-Hours Announcements: Cum. % of Total Abnormal Return (%)	Trading-Hours Announcements: t-Statistic	Nontrading-Hours Announcements: Mean Abnormal Return	Nontrading-Hours Announcements: Cum. % of Total Abnormal Return (%)	Nontrading-Hours Announcements: t-Statistic
−6	0.001[illegible]	1[illegible]	[illegible]778	−0.0004	−1.[illegible]	[illegible]818
−5	0.0013	26.8	[illegible]	[illegible]0001	1.4	0.350
−4	0.0007	17.9	−0.[illegible]	−0.0002	[illegible]	−0.5[illegible]
−3	0.0004	22.2	0.46[illegible]	0.0006	0.2	1.325*
[illegible]	0.0008	[illegible]	1.067	0.000[illegible]	1.4	0.507
−1	0.0003	35.5	0.382	0.0002	2.2	0.318
[illegible]	0.00[illegible]	[illegible]	4.45[illegible]***	0.0192	102.2	10.81[illegible]***
+1	0.00[illegible]	[illegible]	0.869	0.0017	111.0	1.71[illegible]
+2	[illegible]	[illegible]5.0	0.5[illegible]	−0.0019	101.0	[illegible]
[illegible]	[illegible]	1[illegible]9	1.122	0.0004	102.8	[illegible]
+4	0.0004	[illegible]	0.416	−0.0002	101.7	−0.4[illegible]
[illegible]	0.0003	12[illegible]	−0.357	−0.0005	98.9	0.989
+6	−0.00[illegible]	[illegible]	[illegible]	0.0002	100.0	0.307
Following Overnight	0.0021		1.73[illegible]*	0.0001		0.198
Day +1						
+1	−0.000[illegible]		−0.12[illegible]	0.0016		1.[illegible]05**
[illegible]	−0.0001		−0.147	−0.0008		−1.[illegible]

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

hour of trading the following morning.[20] Figures 5 and 6 contain graphs of the CARs calculated from the abnormal returns presented in Tables 4 and 5. Recall from the previous section that approximately 80% of the total CAR earned by transaction +25 is earned within the first seven post-announcement transactions. On average, these seven transactions are completed within 21 minutes after the announcement for the trading-hours group and within [illegible]

[20] As Table 4 shows, there appears to be some significant pre-announcement price adjustment for the NYSE nontrading hours announcements. In particular, average abnormal returns of 0.09% (p < 0.05) are earned during the last [illegible] minutes of trading on the day preceding, the overnight period during which the announcement is made (period −1). We also observe significant abnormal returns of 0.0[illegible]% (p < 0.05) in periods −5 and −3. However, no significant average abnormal returns are observed in the pre-announcement period for the NYSE trading hours announcements.

minutes of the opening trade for the nontrading-hours group. Thus, the clock time and transaction time results are consistent.

The abnormal return results (both clock time and transaction time) suggest that in spite of the occurrence of abnormal transaction returns during several successive transactions after NYSE trading-hours announcements, the majority of the price adjustment to earnings news occurs relatively quickly regardless of release time. Thus, even though the price adjustment is spread over more transactions for the NYSE trading-hours announcements, in terms of clock time, price adjusts dramatically and quickly once post announcement trading begins. Note that because some period of no trading precedes the first post-announcement trade for the nontrading-hours announcements, in clock time relative to the announcement time, the price discovery process is more prolonged for the nontrading-hours announcements.

The results of the same trading strategy applied to the NASDAQ announcements are presented in Table 5. The data in Table 5 indicate that for the NASDAQ trading-hours announcements, the price adjustment is rapid with approximately 59% of the total CAR earned in the 15-minute period containing the release (mean abnormal return of 0.51%, $p<0.01$).[34] No other significant abnormal returns are earned during the following hour and 15 minutes. For the NASDAQ nontrading-hours announcements, the overnight mean abnormal return is significant (mean abnormal return of 1.92%, $p < 0.01$) and accounts for essentially 100% of the total average CAR earned within an hour and a half after the opening of trading. Some slight, further price adjustment is observed during the first 15 minutes of trading, resulting in an average abnormal return of 0.17% ($p < 0.05$) over that period, which is then given back within the next hour and fifteen minutes. After that, no significant abnormal returns are earned. Thus, once again, the price adjustment is very rapid once trading begins.[35]

These results combined with the results in the previous section suggest that on the NASDAQ, the price adjustment to earnings news is swift. The majority of the price adjustment is impounded in the first post-announcement trade, regardless of the release time. Recall from the previous section that approximately 80% of the total CAR earned by transaction +25 is earned within the first seven post-announcement transactions. On average, these seven transactions are completed within 3½ minutes after the announcement for the trading-hours group and within 10 minutes of the opening trade for the nontrading-hours group. Thus, the clock time and transaction time results are consistent.

In summary, the transaction and clock time returns analyses suggest that different price discovery is associated with trading- and nontrading-hours announcements on the NYSE and that similar price discovery is associated with trading- and nontrading-hours announcements on the NASDAQ. Thus, our results support rejection of H_{1C} but not of H_{1N}. For announcements made only during nontrading hours, price discovery is similar for the two exchanges. The largest price adjustment occurs in the one overnight trade surrounding the announcement, with some slight, additional adjustment after the opening. For announcements made only during trading hours, price discovery varies across the exchanges. On the NYSE, price adjustment is spread relatively evenly over the first several post announcement transactions; on the NASDAQ, the majority of the price adjustment is reflected in first post-announcement transaction. Thus, our results support rejection of H_{1N} but not of H_{1C}.

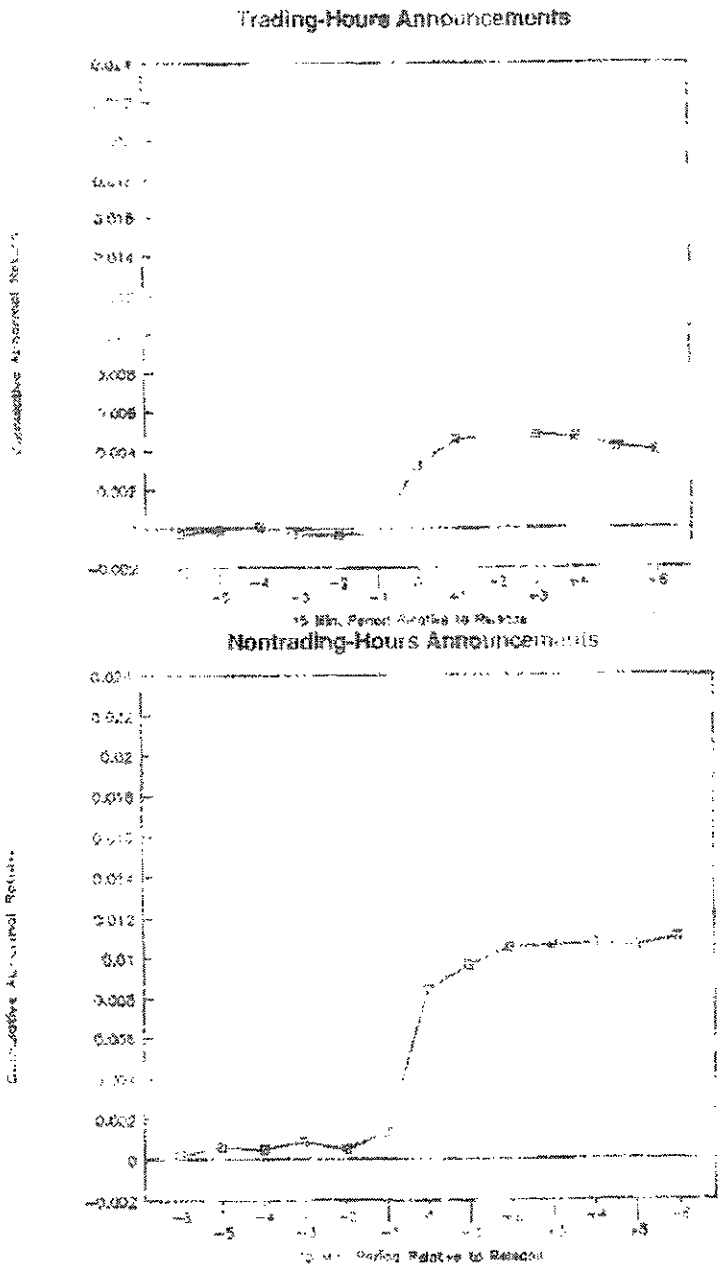
The results in this study differ from those in Francis, Pagach, and Stephan (1992) but are similar to those in Jennings (1991). Jennings documents a similar, large overnight price response to a sample of takeover announcements made during nontrading hours. Francis, Pagach, and Stephan find no market reaction at the open to annual earnings news announced during nontrading hours. They offer two explanations for the result. First, they suggest that characteristics of an *active* market are necessary to impound new information into the stock price. Second, they suggest that traders may submit only partial orders at the open to avoid fully revealing their interpretation of the news. With regard to the first explanation, the evidence in this study indicates that the overnight price change surrounding a quarterly earnings release does, on average, reflect the fact that information has been released. Thus, it is not clear that an active, continuous auction market is necessary for *public* information to be impounded into the price. The finding of slight, additional price adjustment after the opening, however, suggests that an active market may well be necessary for private information, such as traders' diverse interpretations of the news, to be impounded into the price. This is consistent with the findings in French and Roll (1986) that trading reveals private information.[35] Thus, our results suggest that both the public

[34] Recall that 75% of the total CAR earned by transaction +25 is earned by transaction +7. The seventh transaction occurs, on average, 3½ minutes after the announcement. In clock time, 59.5% of the total CAR earned by an hour and a half after the announcement is earned within the first half hour.

[35] However, as just noted, since some period of no trading follows nontrading-hours announcements, one could argue that in clock time (relative to the announcement time), the price adjustment is more prolonged for the nontrading-hours announcements.

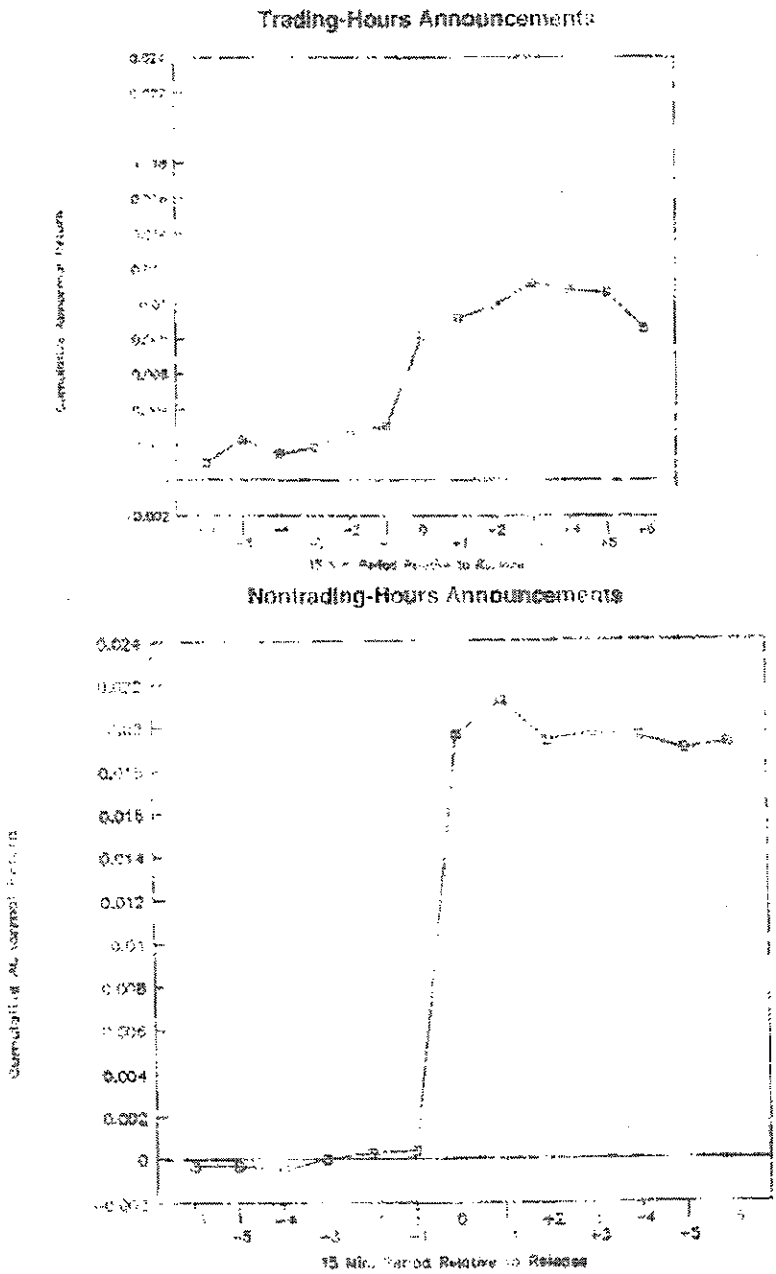
[35] Francis, Pagach, and Stephan (1992) only examine the market response to annual earnings announcements, while we examine the market response to quarterly earnings announcements, which often contain more new

Figure 5. Cumulative Abnormal 15-Minute and Overnight Returns for Trading-Hours and Nontrading-Hours Earnings Announcements on the NYSE



Holding period abnormal returns are measured in 15-minute intervals with the exception of Period 0 for the nontrading-hours announcements. For the trading-hours announcements, Period 0 is the 15-minute interval containing the release for the nontrading-hours announcements, Period 0 is the overnight period containing the release, and Period 1 is the first 15-minute period after the release. Abnormal returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. NYSE announcements are those 1,302 quarterly earnings announcements (excluding the 5 announcements that were accompanied by trading halts) made by 100 NYSE firms during the 1990–1991 time period. Trading hours announcements (N = 5[illegible]) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading hours announcements (N = 8[illegible]) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST.

Figure 6. Cumulative Abnormal 15-Minute and Overnight Returns for Trading-Hours and Nontrading-Hours Earnings Announcements on the NASDAQ



Holding period returns are measured in 15 minute intervals with the exception of Period 0 for the nontrading-hours announcements. For the trading-hours announcements, Period 0 is the 15 minute interval containing the release. For the nontrading-hours announcements, Period 0 is the overnight period containing the release, and Period 1 is the first 15-minute period after the release. Abnormal returns are calculated by adjusting observed returns by a firm-specific, quarter-specific, and time-of-day-specific average return. NASDAQ announcements are those 1,187 quarterly earnings announcements made by 100 NASDAQ firms during the 1990-1994 time period. Trading-hours announcements ($N = 349$) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements ($N = 838$) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST.

announcement itself [illegible] as revelation of private interpretations of the news through post-announcement trading contribute to the observed immediate price movements following an earnings announcement.

D. Supplemental Analysis: Price Continuity and Volume Results

In this section, we examine price continuity following the announcements and trading volume in order to further our understanding of the price discovery processes. Our price continuity analysis is based on the well-documented "reversal tendency" (i.e., negative serial correlation) in intraday transaction prices. The rationale behind the analysis is that the arrival of information is likely to interrupt the normal price reversal tendency and result in an elevated proportion of price continuations (i.e., [illegible] price changes in the [illegible] direction) during the adjustment period. A return to the "normal" level of continuations is typically interpreted as marking the end of the price adjustment process.[34]

We present the relative frequencies of price continuations observed for 10 transactions before and 25 transactions after the earnings announcements of both [illegible] trading and nontrading-hours groups for the NYSE sample in Table 6 and for the NASDAQ sample in Table 7. We calculate a separate "benchmark" level of continuations for each group of announcements.[35]

As Table 6 indicates, for the NYSE trading-hours announcements, we observe approximately 18% continuations for the first six post-announcement [illegible] (benchmark of [illegible]). The observed proportions fall to an average of 13% over the next 10 transactions and then become statistically indistinguishable from the benchmark.[37] These results provide additional support for the conclusions drawn in the previous sections: Price discovery after trading-hours earnings announcements is extended over several post-announcement transactions. The data in Table 6 also show that, for NYSE nontrading-hours announcements, we observe 33% continuations for the overnight trade surrounding the announcement, approximately 6% continuations over the next two trades, and then approximately 11% for the next sixteen trades (benchmark of 8.21%). These results are consistent with a large price adjustment during the [illegible] period of the announcement followed by some slight additional adjustment.

As Table 7 indicates, for the NASDAQ trading-hours announcements, we observe approximately 12% continuations in the first 15 post-announcement trades (benchmark of 9.3[illegible]). Notice that the observed proportions during these trades tend to be only about 3 percentage points higher than the benchmark. Thus, while they are statistically significant, they are not particularly high and therefore not inconsistent with a rapid price adjustment to the news (in transaction time). For the NASDAQ nontrading-hours announcements, we observe 35% continuations for the overnight trade of the announcement and significantly elevated proportions of continuations for the next three transactions ([illegible], 12%, and 11% for each of these transactions, respectively, and a benchmark of 8.[illegible]). Again, these results are consistent with a large price adjustment during the overnight period for the announcement followed by some additional adjustment.

Tables 8 and 9 [illegible] abnormal trading volume in shares measured over 15 minute and overnight holding periods, for the NYSE and the NASDAQ samples respectively.[36] Abnormal volume is calculated by adjusting observed volume over the holding period by a firm-specific, quarter-specific, and time-of-day specific average volume.[37] Consistent with previous research (e.g., [illegible], 1987; Francis, Pagach, and Stephan, 1992; and Morse, 1981), we find that trading volume increases after earnings announcements and stays elevated into day +1.

For the nontrading-hours announcements, period 0 in Tables 8 and 9 is the overnight period containing the announcement. Thus, abnormal trading volume for period 0 is abnormal volume observed during the opening transaction. As Tables 8 and 9 show, we observe significant positive opening abnormal volume on the NYSE but not on the NASDAQ.[38] This is not surprising since the opening transaction on the NYSE is a batched transaction [illegible]

information [illegible] reports. This may [illegible] partially explain the difference in our results.

[34] For details see Patell and Wolfson (1984).

[35] Each group's benchmark level [illegible] calculated as follows. The time of each announcement was determined from the Dow Jones [illegible] database. For each announcement, we then [illegible] of continuations observed during an estimation period (days −30 to −2 [illegible] to the announcement day, which is day 0) based on the announcement [illegible]. Thus, we obtain [illegible] "normal" continuation rate for each announcement based on 525 [illegible] estimation period observations. We averaged these normal continuation rates across all announcements in each group to get four benchmarks.

[37] These results are roughly consistent with [illegible] and Stark (1994). They found that their "high information content" announcements resulted in elevated price continuations through the fourth post-announcement transaction and then again between the eighth and sixteenth post-announcement transactions.

[36] Tables 8 and 9 [illegible] volume counterparts of Tables 4 and 5, which contain abnormal returns.

[37] The firm-specific, quarter-specific, and time-of-day-specific [illegible] volumes are calculated over days −45 to −26 relative to each earnings announcement day (which is day 0).

[38] We also observe significant positive abnormal opening volume on the NYSE [illegible] but not on the NASDAQ, on day +1 [illegible].

Table 6. Relative Frequency of Continuations in Consecutive Price Changes Surrounding Earnings Disclosures: NYSE Announcements

NYSE announcements are those [illegible] quarterly earnings announcements (excluding the [illegible] announcements that were accompanied by earnings halts) made by 100 NYSE firms during the 1990–1992 data period. Trading-hours announcements (N = 480) are those made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements (N = 502) are those made between 4:00 p.m. and 6:30 p.m. EST and those made between 8:00 a.m. and 9:30 a.m. EST. Chi-square statistics are presented for two-by-two contingency table one-tailed tests of equality between the relative frequencies of continuations during the event period and the benchmark period (benchmark percent continuations = 8.1% and 8.2% for the trading-hours and nontrading-hours announcements respectively).

Transaction Number Relative to the Release	Trading-Hours Announcements		Nontrading-Hours Announcements	
	Percent Continuations (%)	Chi-Squared	Percent Continuations (%)	Chi-Squared
−10	11.2	2.528***	7.5	−0.752
−9	12.8	5.836***	8.4	0.144
−8	11.8	3.618***	7.1	−0.870
−7	11.4	3.091***	7.1	−0.876
−6	9.8	0.959	9.0	0.618
−5	[illegible]	1.072	7.9	−0.361
−4	[illegible]	1.936**	9.1	0.917
−3	[illegible]	0.537	8.7	0.530
−2	11.2	3.825***	6.9	−1.080
−1	9.4	1.055	8.6	0.402
+1	18.4	8.411***	32.9	28.401***
+2	13.6	6.961***	8.5	0.884
+3	14.8	6.554***	6.9	−1.392
+4	13.6	5.768***	10.1	1.948**
+5	17.8	10.131***	9.7	1.566*
+6	18.6	11.[illegible]***	10.6	2.463***
+7	14.7	4.980***	13.2	4.131***
+8	15.6	6.123***	9.2	1.051
+9	11.2	3.980***	11.2	3.101***
+10	14.4	5.113***	9.0	0.794
+11	13.2	3.325***	12.8	4.770***
+12	13.2	4.163***	10.1	1.948**
+13	13.0	3.990***	10.3	2.071**
+14	14.0	4.612***	11.5	3.359***
+15	14.0	4.[illegible]***	11.7	3.616***
+16	9.8	1.365**	9.9	1.690**
+17	8.5	0.565	9.6	1.432*
+18	11.2	4.980***	11.2	3.101***
+19	9.6	1.218*	10.7	2.536***
+20	8.2	0.013	9.5	1.309*
+21	9.2	0.859	9.5	1.309*
+22	13.6	4.490***	9.2	1.051
+23	10.2	1.710**	9.1	0.917
+24	12.2	3.[illegible]***	8.9	0.660
+25	11.8	3.[illegible]***	9.2	1.051

***Significant at the 0.01 level
**Significant at the 0.05 level
*Significant at the 0.10 level.

Table 7. Relative Frequency of Continuations in Consecutive Price Changes Surrounding Earnings Disclosures: NASDAQ Announcements

NASDAQ announcements are those 1,187 quarterly earnings announcements made by the NASDAQ firms during the [illegible] 1994 time period. Trading-hours announcements (N = 349) are those made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements (N = 838) are those made between 4:01 p.m. and 6:30 p.m. EST and those made between 8:00 a.m. and 9:30 a.m. EST. Chi-square statistics are presented for tests by two contingency table tests of equality between the relative frequencies of continuations during the event period and the benchmark period (benchmark percent continuations = 0.32% and 3.95% for the trading hours and nontrading hours announcements, respectively).

Transaction Number Relative to the Release	Trading Hours Announcements: Percent Continuations (%)	Trading Hours Announcements: Chi-Squared	Nontrading-Hours Announcements: Percent Continuations (%)	Nontrading-Hours Announcements: Chi-Squared
10	10.0	[illegible]	[illegible]	[illegible]
9	11.6	1.560*	8.2	-0.710
-8	[illegible]	0.642	9.4	0.142
-7	[illegible]	-0.783	11.7	2.798***
-6	[illegible]	[illegible]	3.6	-1.398
-5	6.6	1.753	9.0	0.059
-4	13.2	3.477***	10.0	1.104
-3	10.0	[illegible]	9.2	0.264
-2	[illegible]	[illegible]	[illegible]	[illegible]
-1	13.5	[illegible]	[illegible]	[illegible]
0	14.3	[illegible]	[illegible]	[illegible]
1	20.0	[illegible]	18.6	[illegible]
+2	[illegible]	[illegible]	12.3	[illegible]
+3	[illegible]	[illegible]	10.7	[illegible]
+4	[illegible]	[illegible]	[illegible]	[illegible]
+5	[illegible]	[illegible]	9.7	0.750
+6	10.6	0.832	7.9	-1.063
+7	14.0	[illegible]	9.2	0.265
+8	12.6	[illegible]	9.3	[illegible]
+9	[illegible]	[illegible]	[illegible]	1.105
+10	12.3	[illegible]	8.2	-0.710
+11	10.9	[illegible]	[illegible]	-0.588
+12	12.6	[illegible]	10.1	1.237
+13	14.3	[illegible]	9.1	0.143
+14	[illegible]	[illegible]	8.6	0.385
+15	10.0	[illegible]	6.0	[illegible]
+16	9.5	[illegible]	10.4	[illegible]
+17	10.3	[illegible]	9.7	0.750
+18	11.2	[illegible]	7.8	-1.187
+19	[illegible]	[illegible]	[illegible]	[illegible]
+20	[illegible]	-0.293	8.1	-0.832
+21	11.2	[illegible]	8.7	-0.323
[illegible]	9.7	0.269	10.0	0.981
[illegible]	10.9	1.008	9.5	[illegible]
+24	9.7	[illegible]	7.5	[illegible]
+25	11.8	[illegible]	[illegible]	1.337

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

Table 8. Average 15-Minute and Overnight Mean Abnormal Volume in Shares: NYSE Announcements

Abnormal volume is measured over 15 minute intervals with the exception of Period 0 [illegible] nontrading-hours announcements. For the trading-hours announcements, Period 0 is the 15-minute interval containing the release. For the nontrading-hours announcements, Period 0 is the overnight period containing the release and Period 1 is the first 15-minute period after the release. Abnormal volume is calculated by adjusting observed volume in shares by a firm-specific, quarter-specific, and time-of-day-specific average volume in shares. NYSE announcements are those 1,302 quarterly earnings announcements excluding the 5 announcements that were accompanied by trading halts made by 100 NYSE firms during the 1990-1991 time period. Trading-hours announcements (N = 500) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading hours announcements (N = 802) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST. t-statistics are for the test of the null hypothesis of zero abnormal volume against the alternative of positive abnormal volume.

Period Relative to Announcement	Trading-Hours Announcements: Mean Abnormal Volume	Standard Deviation	t-Statistic	Nontrading-Hours Announcements: Mean Abnormal Volume	Standard Deviation	t-Statistic
−6	1,567	17,746	[illegible]	1,453	22,[illegible]	1.858**
−5	1,243	17,279	1.609*	1,310	18,470	2.0[illegible]
−4	1,270	17,386	1.582*	2,212	29,4[illegible]1	2.1[illegible]**
−3	986	18,790	1.181	[illegible]	24,8[illegible]	0.416
−2	[illegible]	21,018	[illegible]263***	1,[illegible]	26,[illegible]	1.340*
−1	998	13,498	1.630**	2,717	[illegible]	1.950**
0	19,322	11,921	[illegible]	10,984	[illegible]	6.86[illegible]
+1	[illegible]	44,482	[illegible]	8,856	21,810	6.684***
+2	[illegible]	45,194	[illegible]	14,126	40,[illegible]	8.045***
+3	[illegible]	30,646	[illegible]	12,301	[illegible]	8.788***
+4	[illegible]	25,514	[illegible]	[illegible]	[illegible]	8.564***
+5	6,070	29,711	4.568***	11,368	41,[illegible]	[illegible]
+6	6,601	[illegible]	[illegible]	9,088	[illegible]1,322	[illegible]
Following Overnight	3,130	[illegible]	2.0[illegible]	[illegible]	[illegible]	[illegible]
Day +1						
+1	5,706	29,345	3.853***	[illegible]	[illegible]875	6.6[illegible]1***
+2	5,776	30,266	4.268***	[illegible]	[illegible]	6.528***

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

many orders are aggregated and executed during this one transaction) whereas on NASDAQ, it is simply a single trade (i.e., one trade executed by one dealer).[39]

III. Concluding Remarks

For both the NYSE and the NASDAQ, there are a number of reasons to believe that different price discovery follows trading- and nontrading-hours announcements. First, for nontrading-hours announcements, there is a period of no trading, which permits broad dissemination of that information. Second, for both the NYSE and the NASDAQ, certain aspects of the opening procedures differ from the

[39] We also calculated average abnormal order size per transaction for transactions −10 to +25 for each group of announcements. For the NYSE trading-hours announcements, we observe significantly positive average abnormal order size for the first four post-announcement trades as [illegible] for transactions +6, +7, +8, and +9. For transaction +1, 1,200 extra shares were traded on average, and for the rest of the significant transactions, 500 additional shares were traded on average. For the NYSE nontrading-hours announcements, we observe significant average abnormal order size for transactions −2, −1, and +1 only, with 1,300 additional shares traded on average during transactions −2 and −1 and 1,000 additional shares traded in the matched opening trade transaction. For the NASDAQ trading-hours announcements, we generally observe no significant elevation or decline in order size during the 35 transactions surrounding the announcements. However, for the NASDAQ nontrading-hours announcements, transactions +2, +3, +4, +6, and +9 are significantly smaller on average. In particular, we observe 470 shares less on average traded during these transactions.

Table 9. Average 15-Minute and Overnight Mean Abnormal Volume in Shares: NASDAQ Announcements

Abnormal volume is measured over 15-minute intervals with the exception of Period 0 for trading-hours announcements. For trading-hours announcements, Period 0 is the 15-minute interval containing the release. For nontrading-hours announcements, Period 0 is the overnight period containing the release, and Period +1 is the first 15-minute period after the release. Abnormal volume is calculated by adjusting observed volume for a firm-specific, quarter-specific, and time-of-day-specific average volume in shares. NASDAQ announcements are those 1,187 quarterly earnings announcements made by 100 NASDAQ firms during the 1990–1994 time period. Trading-hours announcements (N = 439) are those announcements made between 9:30 a.m. and 4:00 p.m. EST. Nontrading-hours announcements (N = 858) are those announcements made between 8:00 a.m. and 9:30 a.m. EST and 4:00 p.m. and 6:30 p.m. EST. Statistical significance of the test of the null hypothesis of no abnormal volume against the alternative of positive abnormal volume.

	Trading-Hours Announcements			Nontrading-Hours Announcements		
Period Relative to Announcement	Mean Abnormal Volume	Standard Deviation	t-Statistic	Mean Abnormal Volume	Standard Deviation	t-Statistic
-5	1,929	16,047	2.490***	6,1[illegible]	30,892	5.630***
-4	[illegible]***	18,158	3.189***	5,[illegible]	22,626	4.530***
-3	6,[illegible]	36,434	[illegible]***	8,169	36,890	6.502***
-2	8,159	22,956	7.261***	13,502	[illegible],257	7.011***
-1	4,843	[illegible],982	[illegible]***	12,[illegible]6	[illegible],[illegible]78	8,[illegible]
0	5,819	[illegible]	[illegible]***	[illegible],780	66,[illegible]52	9,7[illegible]
+1	[illegible],[illegible]49	30,[illegible]	[illegible]***	[illegible]	2,536	[illegible],[illegible]9
+2	[illegible],[illegible]91	34,[illegible]91	6.692***	[illegible]	244,649	15.405***
+3	13,[illegible]**	37,691	[illegible]***	[illegible]	[illegible]38,865	1.162***
+4	9,456	28,835	[illegible]***	76,6[illegible]	262,263	13.[illegible]***
+5	9,414	[illegible],[illegible]**	[illegible]***	[illegible],[illegible]880	131,[illegible]85	12.[illegible]***
+6	[illegible],[illegible]73	35,613	[illegible]***	[illegible],[illegible]93	108,160	12.[illegible]***
+7	[illegible],[illegible]93	35,446	[illegible]***	[illegible]	[illegible],[illegible]59**	10.963***
Following Overnight	[illegible]1	[illegible],832	[illegible].138	[illegible]91	[illegible],522	[illegible].[illegible]42
Day +1						
+1	11,522	56,[illegible]33	3.888***	[illegible],[illegible]**	[illegible],[illegible]51	[illegible].[illegible]31***
+2	7,836	35,313	[illegible].145***	[illegible],[illegible]**	[illegible],[illegible]14	9.085***

***Significant at the 0.01 level.
**Significant at the 0.05 level.
*Significant at the 0.10 level.

procedure in place during the trading day. On the NYSE, a call market opens trade and a continuous auction is in place during the rest of the trading day. On the NASDAQ, the same quote-driven, dealer market is in place for all trades; however, the opening trade is preceded by an informal pre-opening price discovery process. Finally, the nature of competition among market participants is different on the NYSE and the NASDAQ.

We analyze price discovery following quarterly earnings announcements made by 100 NYSE firms and 100 NASDAQ firms during the 1990–1994 time period. Our results indicate that in transaction time, price discovery differs for nontrading- and trading-hours announcements on the NYSE but not on the NASDAQ. In particular, on both exchanges, the majority of the price response to nontrading-hours earnings announcements is realized during the opening trade. However, on the NYSE, the price adjustment to trading-hours earnings announcements is spread evenly over the first several post-announcement trades. On the NASDAQ, the price adjustment to trading-hours earnings announcements is concentrated in the first post-announcement trade with only slight adjustment in the next several transactions. Although

transaction time analysis indicates some differences in price discovery, when clock time is considered, price adjusts rapidly for both types of announcements on both exchanges. Thus, any differences in price discovery are reflected in the transactions immediately following the release. Consistent with prior research, we find that post-announcement trading volume is abnormally high and stays elevated into the next trading day regardless of announcement time or exchange.

The results in this paper suggest that markets with different microstructures may have different price discovery processes for news releases. Currently, established stock exchanges are undergoing rapid technological change, and new stock exchanges are being formed in emerging markets. The results presented in this paper provide some insight into the way certain types of markets impound information into price. Future research could examine the ability of other types of microstructures to impound information into price (e.g., Hong Kong's computerized order matching system; Tokyo's match making call market system; and Milan's three-phase opening system followed by continuous trading). ■

References

Amihud, Y. and H. Mendelson, 1987, "A [illegible] Efficiency and Trading [illegible] Evidence from the [illegible] Stock Market," *Journal of Finance* (December), 1765-1[illegible].

Bamber, L.S., 1987, "Unexpected Earnings, Firm Size and Trading Volume Around Quarterly Earnings Announcements," *Accounting Review* (July), 510-532.

Brown, L.D., P.A. Griffin, R.L. Hagerman, and M.E. Zmijewski, 1987a, "Security Analyst Superiority Relative to Univariate Time-Series Models in Forecasting Quarterly Earnings," *Journal of Accounting and Economics* (April), 61-88.

Brown, L.D., P.A. Griffin, R.L. Hagerman, and M.E. Zmijewski, 1987b, "An Evaluation of Alternative Proxies for the Market's Assessment of Unexpected Earnings," *Journal of Accounting and Economics* (June), 159-193.

Brown, L.D. and M.S. Rozeff, 1978, "The Superiority of Analyst Forecasts as Measures of Expectations: Evidence From Earnings," *Journal of Finance* (January), 1-16.

Brown, P., G. Clinch, and G. Foster, 1992, "Market Microstructure and Capital Market Information Content Research," *Studies in Accounting Research* [illegible], American Accounting Association.

Chen, C.R. and N.J. Mohan, 1994, "Timing the Disclosure of Information: Management's View of Earnings Announcements," *Financial Management* (Autumn), [illegible].

Cowan, A.R., R.B. Carter, F.H. Dark, and A.K. Singh, 1992, "Explaining the NYSE Listing Choices of NASDAQ Firms," *Financial Management* (Winter), 73-86.

Francis, J., D. Pagach, and J. Stephan, 1992, "The Stock Market Response to Earnings Announcements Released During Trading and Non-trading Periods," *Journal of Accounting Research* (Autumn), 165-184.

French, K. and R. Roll, 1986, "Stock Returns and Variances: The Arrival of Information and the Reaction of Traders," *Journal of Financial Economics* (February), 5-26.

Fried, D. and D. Givoly, 1982, "Financial Analysts' Forecasts of Earnings: A Better Surrogate for Earnings Expectations," *Journal of Accounting and Economics* (January), 2-11.

Glass, G.[illegible], 1966, "Variance Formulas for the Mean Difference and Coefficient of Concordance," *Journal of the American Statistical Association* (September), 548-[illegible].

Harris, L., 1986, "A Transaction Data Study of Weekly and Intradaily Patterns in Stock Returns," *Journal of Financial Economics* (January), 99-117.

Hopewell, M. and A. Schwartz, 1978, "Temporary Trading Suspensions in Individual NYSE Securities," *Journal of Finance* (December), 1355-1373.

Jennings, R., 1994, "Intraday Changes in Target Firms' Share Price and Bid-Ask Quotes Around Takeover Announcements," *Journal of Financial Research* (March), [illegible].

Jennings, R. and L. Starks, 1986, "Earnings Announcements, Stock Price Adjustment, and the Existence of Options Markets," *Journal of Finance* (March), 107-125.

Lee, C., M. Ready, and P. Seguin, 1994, "Volume, Volatility, and New York Stock Exchange Trading Halts," *Journal of Finance* (March), 183-214.

Morse, D., 1981, "Price and Trading Volume Reaction Surrounding Earnings Announcements: A Closer Look," *Journal of Accounting Research* (Autumn), 374-383.

Patell, J. and M. Wolfson, 1984, "The Intraday Speed of Adjustment of Stock Prices to Earnings and Dividend Announcements," *Journal of Financial Economics* (April), 223-252.

Schwartz, R. and J. Shapiro, 1991, "The Internationalization of Equity Markets: Challenges and Implications," presented at Recent Developments in Finance Conference in Honor of Arnold W. Sametz.